

## BOGUS CREEK SALMON STUDIES

PROJECT NUMBER: 2000-FP-15  
COOPERATIVE AGREEMENT: 14-48-11333-00-JO16.  
PERIOD COVERED: October 1, 1999 - September 30, 2000

### ABSTRACT

The California Department Fish and Game operated a fish marking weir and conducted carcass surveys on Bogus Creek in the fall of 1999. The primary purpose of the study was to determine the escapement of fall-run chinook salmon and describe the general characteristics of the spawning run. The chinook spawning run began on about 24 September and migration into the creek ended on about 9 November. The run peaked during the third week of October. Approximately 6,165 chinook salmon were estimated to have entered Bogus Creek during the 1999 spawning season. Based on scale analysis results provided by the Klamath River Technical Advisory Team, the run included approximately 2,628 grilse (age 2) and 3,537 adults (age 3). Females comprised 48% of the run and males comprised the remaining 52%. The average fork length of grilse was 52 cm (range, 31-59 cm) and the average fork length of adults was 69 cm (range, 60-99 cm). Heads were recovered from a total of 93 adipose fin clipped fish that were observed either at the fish marking weir or during carcass survey efforts. Of these, 83 tags originated from Iron Gate Hatchery and 11 tags were either unreadable or could not be recovered. Expansions of the coded wire tags collected indicate that approximately 2,915 or 47.3% of the chinook salmon that spawned in Bogus Creek were of hatchery origin. Forty eight percent of the adipose fin clipped fish collected were recovered in the lower 0.25 miles of Bogus Creek, downstream of the fish marking weir. Based on this information, it appears that the majority of chinook salmon that spawn in this lower reach (Reach 1) are of hatchery origin, while the upper reaches of the creek are used more extensively by chinook salmon of natural origin.

PERIOD COVERED: Bogus Creek Salmon Studies.

PROJECT NUMBER: 2000-FP-15

COOPERATIVE AGREEMENT: 14-48-11333-00-JO16.

PERIOD COVERED: October 1, 1999 - September 30, 2000

## INTRODUCTION

Bogus Creek is the first major tributary to the Klamath River downstream of Iron Gate Dam and Fish Hatchery and is a major chinook salmon spawning stream. The California Department of Fish and Game (Department) has conducted chinook salmon (*Oncorhynchus tshawytscha*) spawner escapement estimates for the Klamath River Basin since 1978. Approximately 27% (10,420 fish), 28% (9,809 fish), and 37% (6,630 fish) of the total number of adult chinook salmon natural spawners within in the Klamath River, upstream of the Trinity River confluence, were estimated to have entered Bogus Creek to spawn during the 1996, 1997, and 1998 seasons, respectively.

The accuracy of the ocean stock abundance estimates and preseason projections would be compromised if chinook salmon spawner escapement information for Bogus Creek were not developed. In addition, spawner escapement surveys in Bogus Creek also allow for recovery of coded-wire-tag data and other important biological information necessary to describe the annual characteristics of the chinook salmon population. Collection of length, sex, and scale sample data also provide information necessary to accurately describe the growth, age and sex ratio characteristics for each run.

During the spawning season of 1999 the Department once again conducted fall chinook salmon surveys on Bogus Creek with the following study objectives:

- a) Determine the in-river run size (escapement) of fall chinook salmon returning to Bogus Creek during the 1999 season.
- b) Determine run timing, spawning distribution, length frequency, and sex ratio for fall chinook salmon in Bogus Creek.
- c) Collect scale samples and recover heads from adipose fin-clipped, presumably coded-wire-tagged salmon.
- d) Record information on coho salmon and steelhead observed during the course of this work

### **STUDY AREA**

Bogus Creek is located entirely in Siskiyou County and is the first major tributary to the Klamath River downstream of Iron Gate Dam. Bogus creek is fed by several springs throughout its length which contribute cooler water and provide favorable conditions for spawning and rearing salmonids and other resident cool water species. The headwaters of the creek originate in the Klamath National Forest northwest of Willow Creek Mountain at an elevation of 1,599 meters (5,197 ft). The upper reach of the creek, from its headwater to the confluence of Cold Creek, flows in northerly direction through a steep sided canyon for about 15.4 kilometers (9.6 miles) and has an average stream gradient of approximately 49.7 meters per kilometer (259 feet per mile). This upper section provides habitat for steelhead trout and various native and non-native resident species. The steep gradient, smaller channel and reduced stream flows during the spawning season prevents use of this reach by spawning chinook salmon.

From the confluence of Cold Creek downstream, Bogus creek flows in a westerly direction for an additional 7.5 kilometers (4.7 miles) through mostly private lands before entering the Klamath River. Additional tributary accretions, combined with a more gradual stream gradient (14.3 meters per kilometer; 74 feet per

mile) and abundant spawning gravels, provide favorable habitat conditions for spawning and rearing chinook salmon. The vast majority of chinook salmon spawning occurs in this lower section of stream. A fish ladder was constructed in this reach during the mid 1900's to provide fish passage over a bedrock waterfall and small dam located at about stream kilometer 5.60 (3.48 miles). The ladder appears to provide adequate passage as adult chinook salmon have been observed upstream of this structure during the spawning season. There is also a small natural waterfall (~4 feet) located at stream kilometer 2.09 (3.36 miles) and adult chinook salmon have little difficulty navigating these falls. There are no other migration obstacles present in the reach.

## METHODS

The escapement estimate for Bogus Creek is derived through a combination of data collection methods which include operation of a fish marking weir and collection of mark and recapture carcass survey data for the upper reaches of the creek, and a direct count of the number of spawners observed in the creek downstream of the weir.

The Bogus Creek fish marking weir is located adjacent to the Iron Gate Hatchery, approximately 0.41 kilometers (0.25 miles) upstream from the mouth of Bogus Creek. The weir was installed on 24 September and was operational that same day. The weir was operated during daylight hours (6 to 8 hours) seven days a week throughout the fall chinook salmon run period. All fish trapped at the weir were identified to species, measured to fork length, sexed, and examined for the presence of any tags, fin clips or other abnormal marks and/or scars. All fish examined with an adipose fin clip were sacrificed for later coded wire tag recovery and analysis. All other fish were marked with a punch to the right operculum and released for later recovery during the carcass survey.

Carcass surveys were conducted from the mouth of Bogus Creek upstream to the weir (Reach 1), from the weir upstream to the natural water fall (Reach 2A), from the natural waterfall upstream to the property owned

by Ms. Janet M. Danse (Reach 2B), and from the Danse property upstream to the bottom of the fish ladder (Reach 3A). A map depicting the survey reach boundaries is presented in Figure 1. Permission to access Bogus Creek upstream of the fish ladder could not be obtained in 1999. Therefore, carcass surveys in this upper reach could not be conducted.

Carcass surveys were conducted twice a week throughout the chinook salmon spawning season. The first survey occurred on 25 October and the last survey occurred on 22 November. A total of nine (9) surveys were conducted during the season. Each survey was conducted by a crew consisting of at least two persons. Every carcass found was identified to species, examined for the presence of marks (opercle punch, adipose fin clip), sexed, and measured to fork length (cm). Heads were collected from all adipose fin clipped fish to recover the coded wire tag for subsequent reading and analysis. Scale samples were taken from all fish when possible. In addition, observers noted the extent of spawn contributed by each female to determine whether that fish had died prior to spawning.

The spawner escapement for the area upstream of the fish marking weir was calculated using the Petersen mark recapture equation described by Ricker (1975) as follows:

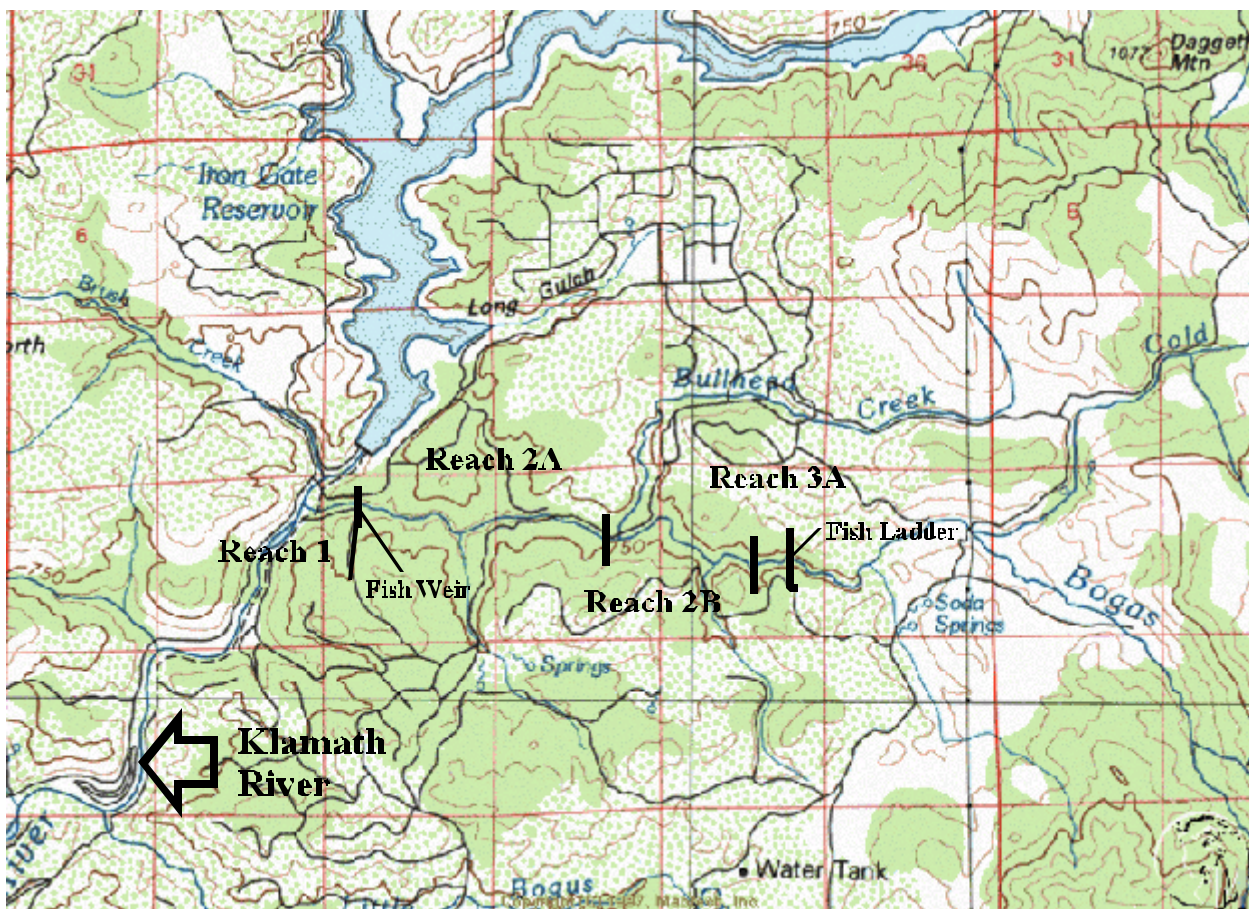
$$\frac{(M+1) \times (C+1)}{(R+1)}$$

Where: M = The number of salmon marked at the weir.

C = The number of marked and unmarked salmon examined in the carcass survey and as wash backs at the weir.

R = The number of marked salmon recovered in the carcass survey and as wash backs at the weir.





**Figure 1.** Map of Bogus Creek showing the location of the fish marking weir and carcass survey reaches sampled during the 1999 chinook salmon spawning season.

Because Reach 1 is located in the 0.41 kilometers (0.25 miles) of Bogus Creek downstream of the fish marking weir, a Petersen Mark Recapture estimate could not be calculated for this reach. Therefore, the spawner escapement estimate for this short reach was derived from a direct count of the number of carcasses recovered during the carcass surveys. The entire escapement estimate for the creek is the sum total of the Petersen Mark Recapture estimate for the area upstream of the fish marking weir and the direct count of the number carcasses observed in Reach 1.

To determine the number of grilse and adults present in the spawning run a length frequency histogram was developed from data collected during the carcass survey. Based on the examination of the length frequency distribution observed, biological staff used professional judgement and experience to determine the fork length that was believed to best denote the age class separation between grilse (2 year old fish) and adults (3 year old fish). The resulting proportion between grilse and adult fish observed in the length frequency distribution was then applied to the total population estimate to estimate the number of grilse and adults present in the entire spawning run. This annual estimate is preliminary and may be modified once the Technical Advisory Team to the Klamath Fisheries Management Council completes their analysis of scales collected during the survey effort. Therefore, the preliminary estimate of the number of grilse and adults, which is based on length frequency analysis, and the final determination of the number of grilse and adults, which is based on the results of scale analysis, may differ slightly.

## RESULTS AND DISCUSSION

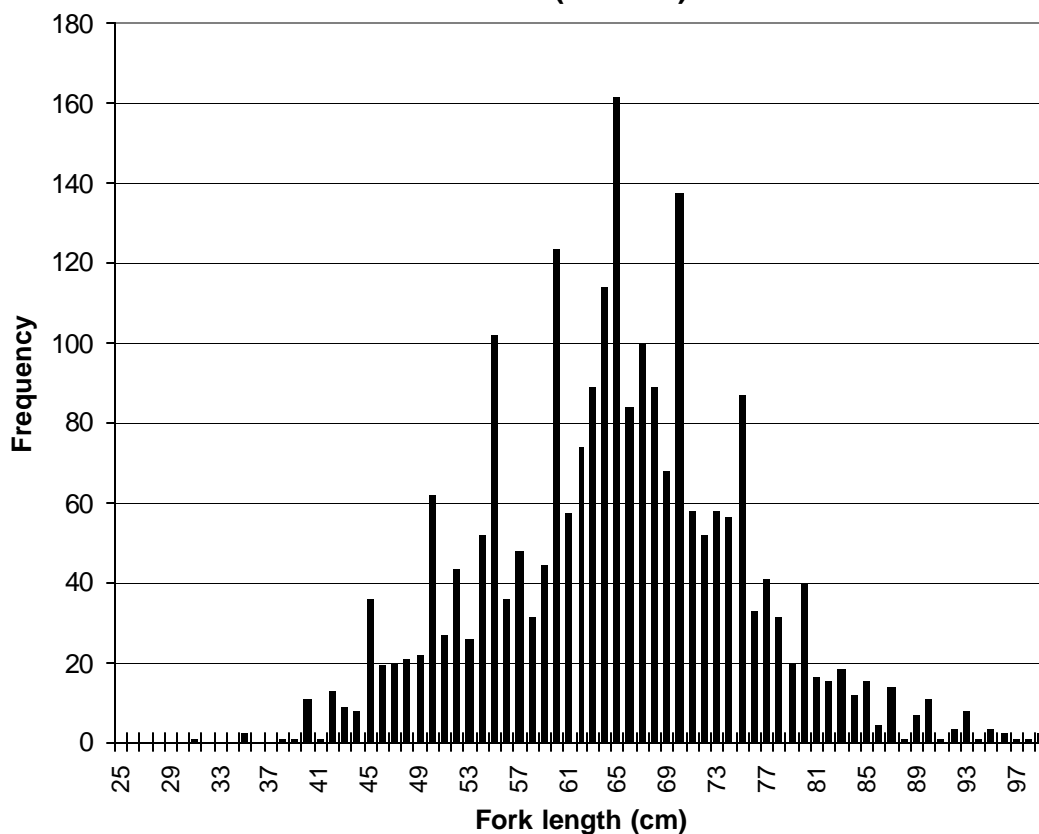
### Run Size and Composition

The fall-run chinook salmon escapement estimate for Bogus Creek in 1999 was 6,165 fish (Appendix 1). The results of the Petersen Mark Recapture estimate for the reach of Bogus Creek upstream of the weir was 5,318 salmon with a 95% lower confidence limit of 4,572 and an upper limit of 6,185 salmon. A direct count of 822 fall chinook salmon carcasses were observed in Reach 1. The number of fall chinook salmon spawners in Bogus Creek comprised approximately 34% of the total number of natural spawners that returned to the Klamath River Basin upstream of the Trinity River confluence in 1999.

Based on examination of the length frequency histogram developed from the carcass survey data collected, the Department estimated grilse to be  $\leq 59$  cm fork length and adults to be  $> 59$  cm fork length (Figure 2). Based on this preliminary determination, the total escapement to Bogus was comprised of 1,673 (27%)



**Figure 2. Length frequency histogram of spawning chinook salmon observed in Bogus Creek during carcasse surveys, 1999 (n=2346)**



grilse and 4,492 (73%) adults. The Karuk Tribal Fisheries Department analyzed scale samples collected by Project personnel from chinook salmon observed at the fish marking weir and carcass survey efforts. Based on their analysis and subsequent discussions with the Technical Advisory Team to the Klamath Fisheries Management Council, grilse and adult percentages were adjusted. They determined that 43% of the chinook salmon escapement to Bogus Creek were grilse, with adults comprising the remaining 54% of the run. A copy of their report is provided in Appendix B. The Department used the percentage adopted by the Klamath River Technical Advisory Team to determine the



grilse and adult contributions in our final escapement estimate of the chinook salmon return to Bogus Creek in 1999 (Table 1).

<b>Table 1. Fall chinook salmon spawner escapement for Bogus Creek, 1999</b>		
Grilse	Adults	Total
2,628	3,537	6,165

### **Contribution of Hatchery Origin Fall Chinook Salmon**

Heads were recovered from 93 adipose fin-clipped chinook salmon in Bogus Creek during the 1999 season. Of these, 82 fish were chinook salmon progeny originating from Iron Gate Hatchery and 11 tags were either unreadable or could not be recovered. An estimate of the total number of hatchery origin chinook salmon that escaped to Bogus Creek in 1999 was derived based on an expansion of the number coded wire tagged fish estimated to occur in Bogus Creek divided by the percentage of the chinook salmon tagged within each tag group released from Iron Gate Hatchery. (Table 2). Approximately 2,915 of the 6,165 chinook salmon, or 47.3% of the fall-run chinook salmon that returned to Bogus Creek in 1999 were of hatchery origin. Of these, approximately 239 (8.2%) were age 4, 932 (32%) were age 3, and 1,744 (59.8%) were grilse. Yearling releases from the hatchery accounted for approximately 10.5%, and smolt releases accounted for approximately 89.5% of the hatchery contribution observed in Bogus Creek.

**Table 2. Estimated contribution of Iron Gate Fish Hatchery chinook salmon to Bogus Creek in 1999.**

Tag Code Group	Release Size (#/lb)	Release Date	Expansion Factor	Bogus Creek 1/ CWT Expansion Est.	Estimated Contribution
-------------------	---------------------------	-----------------	---------------------	--------------------------------------	---------------------------

Age 4					
0601020204	84	06/03/1996	3.41%	1	29
0601020205	84	06/03/1996	3.41%	1	29
0601020206	7.2	11/13/1996	22.70%	22	97
0601020207	7.2	11/12/1996	22.70%	19	84
<b>Subtotal</b>					<b>239</b>

Age 3					
0601020208	104	06/02/1997	3.72%	2	54
0601020209	141	06/02/1997	3.72%	13	350
0601020210	104	06/02/1997	3.72%	12	323
0601020211	141	06/02/1997	3.72%	3	81
063830	7.8	11/05/1997	8.76%	7	80
063831	7.8	11/05/1997	8.76%	4	46
<b>Subtotal</b>					<b>932</b>

Grilse					
0601020212	63	06/08/1998	3.78%	37	978
0601020213	63	06/08/1998	3.78%	5	132
0601020214	63	06/08/1998	3.78%	24	634
<b>Subtotal</b>					<b>1,744</b>

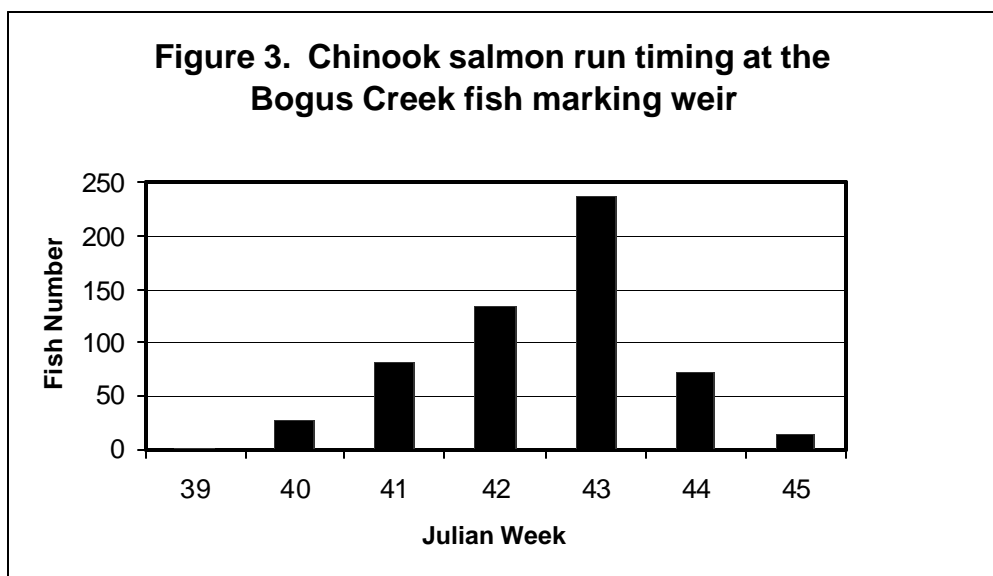
**Total Estimated Hatchery Contribution      2,915**

1/ cwt expansion to Bogus Creek was estimated through expansion of cwts observed in the carcass survey plus observed number of cwts recovered at the fish marking weir.



## Run Timing

The first chinook salmon to enter Bogus Creek was observed at the fish marking weir on 24 September. However, no additional fish were observed until four days later on 28 September, after which time, fish were observed consistently each day until 9 November when only one fish was observed. Operation of the fish marking weir was Terminated on 9 November when it became apparent that the run migration period was effectively over. A total of five hundred fifty seven (557) chinook salmon and four (4) coho salmon were processed at the fish marking weir during the season. The run peaked during the week of 22 October (Julian week 43) and declined steadily over the next two weeks until 9 November (Julian week 45) when operation of the weir ceased (Figure 3).



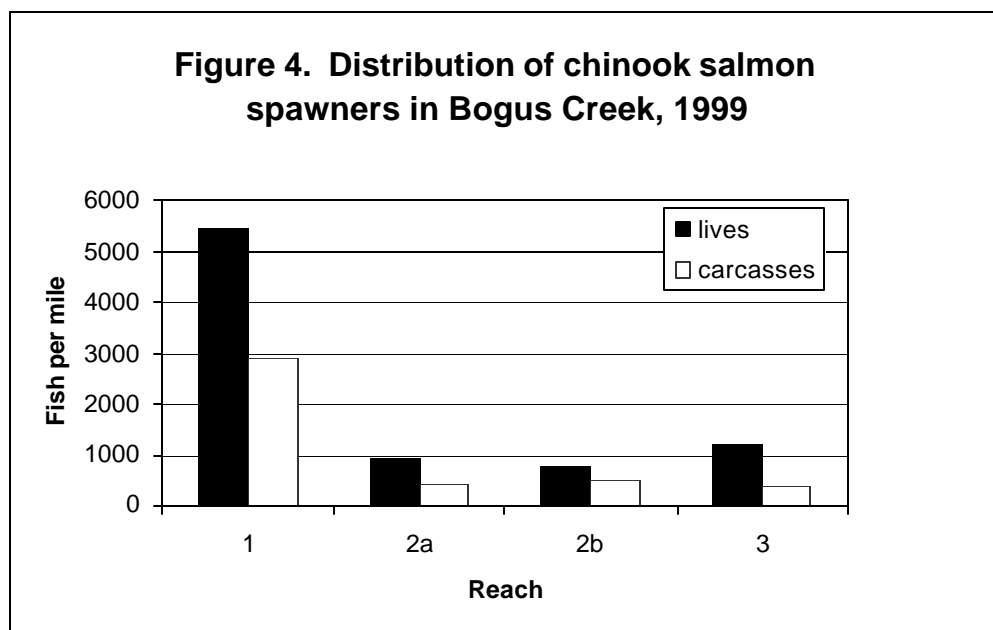
## Spawner Distribution

A description of the spawner distribution in Bogus Creek was determined from carcass survey information collected during the season. Carcass survey crews also recorded the number of live chinook salmon observed within each reach. This information allowed for comparison between the distribution of live chinook salmon observed and chinook salmon carcass recovery efforts.

Information regarding the distribution of chinook salmon observed in Bogus Creek is presented in Table 3 and Figure 4.

**Table 3. Distribution of spawning chinook salmon observed during carcass surveys in Bogus Creek, 1999**

	Reach Number			
	1	2A	2B	3A
Reach Len. (Miles)	0.25	1.83	1.11	0.29
Live Chinook	1387	1712	842	360
Carcasses	738	739	527	110
Density of Live Chinook (fish/mile)	5482	936	759	1241
Density of Chinook Carcasses (fish/mile)	2917	404	475	379



The density of both live and dead chinook salmon observed in Reach 1, located downstream of the fish marking weir, was much greater than those densities observed in Reaches 2A, 2B, and 3A. Upstream of the fish marking weir the density of chinook salmon observed was similar for all three of the reaches surveyed. Several factors may be responsible for the disproportionate use of Reach 1 by spawning chinook salmon relative to the other reaches of creek that were surveyed. Reach 1 is located nearest to Iron Gate Hatchery and this likely influenced spawning use in these reach. Of the 93 adipose fin clipped fish observed in Bogus Creek 45 (48.4%) adipose fin clipped chinook were recovered in Reach 1. Reach 1 only contains 0.25 miles or 5% of the 4.7 miles of creek available to chinook salmon. Based on this information, use of Bogus Creek by hatchery origin chinook salmon is heavily skewed towards Reach 1, while the upper reaches of the creek received greater use by chinook salmon of natural origin.



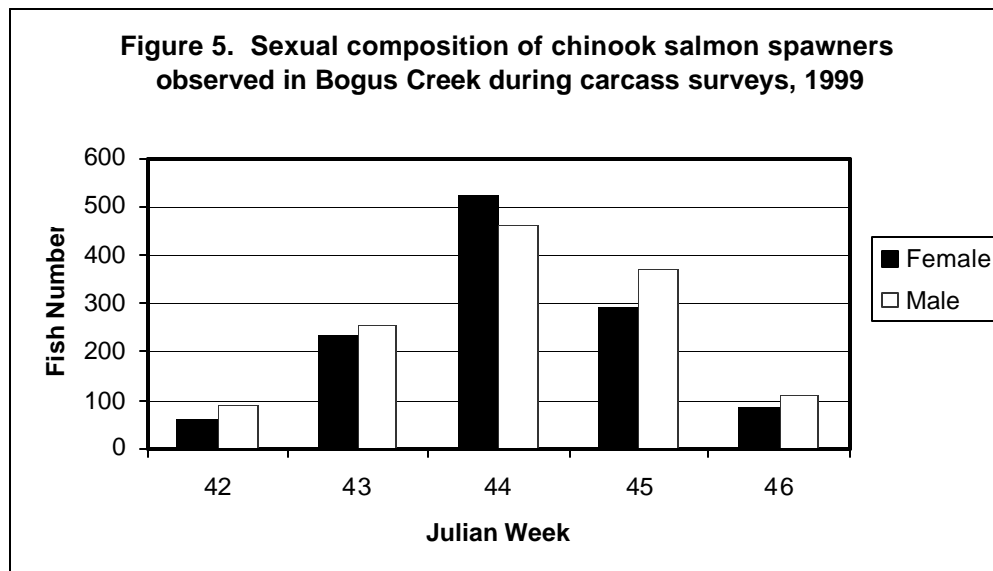
## Length Frequency Distribution

Fork length measurements were conducted on 2,346 of the chinook salmon carcasses recovered during carcass surveys. A length frequency histogram was constructed from this data (see Figure 2). A nadir in the length frequency histogram occurs at 59 cm fork length. For the preliminary determination of the break point between grilse and adults, which is provided to the Klamath River Technical Advisory Team for harvest model development, Project biologists defined grilse as fish  $\geq$  59 cm fork length. Therefore, it was determined that grilse comprised approximately 27% of the run and adult chinook salmon comprised approximately 73% of the run.

As stated earlier in this report, scale analysis results provided by the Klamath River Technical Advisory Team forced a change in age class separation which departed from the length frequency interpretation presented here. They determined that 43% of the chinook salmon escapement to Bogus Creek were grilse, with adults comprising the remaining 54% of the run.

## Sex Ratio

The ratio of male and female chinook salmon was determined from carcass survey data and carcasses that drifted back to the fish weir. From a total of 2,490 carcasses that were examined, 1,295 were males and 1,195 were females. Females comprised 48% of the sample and males comprised the remaining 52% of the sample (Figure 5).



## Coho Salmon and Steelhead Observations

One steelhead trout (*O. mykiss*) carcass and five coho salmon (*O. kisutch*) carcasses were observed during spawning ground surveys or as wash backs to the fish marking weir in 1999. The steelhead trout recovered was a female with a forklength of approximately 64 cm. She had spawned, and was recovered in reach 3A on 25 October. All five of the adult coho salmon carcasses recovered were males and they ranged in fork length from 53 cm to 78 cm. Three of the coho salmon were recovered during surveys conducted on 18 November in Reach 2B, one during the survey conducted on 11 November in Reach 1, and one during the survey conducted 15 November in Reach 2B. One of the coho salmon (75 cm) collected in Reach 2B bore a left maxillary clip identifying this fish as progeny produced at Iron Gate Hatchery. It is uncertain from the data collected whether the other coho salmon had a left maxillary clip.

A total of four (4) coho salmon were processed at the fish marking weir during the season, none of which were recovered during the carcass survey. Of the four (4) coho salmon observed, three were

males and one was female. The three males passed through the weir on 6 October, 11 October, and 7 November. The female coho salmon passed through the weir on 13 October. The presence of left maxillary clips to these fish is uncertain. Future study efforts, beginning in the 2001 spawning season will examine all coho salmon for the presence or absence of a maxillary clip to eliminate uncertainty in future data collection efforts.

## REFERENCES

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada, Bulletin 191; Department of Fisheries and Oceans, Ottawa, Canada. 382 pp.

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Mark Hampton  
Associate Biologist and Leader,  
Klamath River Project



## APPENDIX A

### Fall-Run Chinook Salmon Escapement Estimate

Bogus Creek, 1999

#### Petersen Mark and Recapture estimate results for Bogus Creek, 1999

M = 535 = The number of chinook marked at the weir minus the number recovered in Reach 1.

C = 1,656 = The number of chinook carcasses that were examined in survey reaches 2, 3, and in the washback sample.

R = 166 = The number of punched carcasses found in Reaches 2, 3, and in the washback sample.

$$\text{Estimate} = \frac{(M+1)(C+1)}{(R+1)}$$

95% Confidence Intervals of R (From Ricker, 1975):  $x_1 = 193.25$ ;  $x_2 = 142.59$

Escapement Estimate For Reaches 2 and 3 = 5,318

Lower Limit = 4,572

Upper Limit = 6,185

Number of live chinook observed during last survey = 25

Chinook escapement estimate upstream of weir = 5,343

Plus number of chinook observed in Reach 1 = 822

**Total estimated chinook salmon spawner escapement = 6,165**

Based on the spawning ground survey (sgs) sample (n=2,346), grilse were estimated to be less than or equal to 59 cm forklength. Therefore, 636 (27.14%) of the 2,346 chinook sampled were grilse.

Expansion of the estimated run size by grilse proportion estimated in the sgs yields an escapement estimate comprised of 1,673 grilse and 4,492 adults.

---

**1999 Klamath River Fall Chinook Age Composition Report**

**Yurok Tribal Fisheries Department**

**Hoopla Valley Tribal Fisheries Department**

**Copies of Bogus Creek Computer Data, 1999**

**Spawning Ground Survey Data**

**Fish Marking Weir Data**

**Weir Wash Back Data**